Claims

What is claimed is:

1. A variable compression ratio internal combustion engine, comprising:

an engine block defining at least one cylinder;

a head connected with said engine block, including an air intake port, and an exhaust port;

a piston slidable in each cylinder;

a combustion chamber being defined by said head, said piston, and said cylinder;

an air intake valve controllably movable to open and close the air intake port;

an air supply system including at least one turbocharger fluidly connected to the air intake port;

a fuel supply system operable to controllably inject fuel into the combustion chamber at a selected timing; and

a variable intake valve closing mechanism configured to keep the intake valve open by selective operation of the variable intake valve closing mechanism.

2. The engine of claim 1, further including an air intake valve assembly connected with said intake valve, said air intake valve assembly adapted to cyclically move said intake valve.

3. The engine of claim 2, wherein said air intake valve assembly includes a cam connectable with a rocker arm, said rocker arm being connected with said intake valve.

4. The engine of claim 2, wherein the variable intake valve closing mechanism is operated at least one of hydraulically, pneumatically, mechanically, and electronically.

5. The engine of claim 1, further including a controller configured to operate the intake valve to remain open for a portion of a second half of a compression stroke.

6. The engine of claim 1, wherein the fuel supply system includes a fuel injector assembly.

7. The engine of claim 6, wherein the fuel injector assembly is operated at least one of hydraulically, mechanically, and electronically.

8. The engine of claim 1, wherein the air supply system includes a second turbocharger arranged in series with the at least one turbocharger.

9. The engine of claim 1, wherein the at least one turbocharger includes a turbine and two compressors.

10. The engine of claim 1, wherein the at least one turbocharger has a pressure ratio of at least 4:1 with respect to atmospheric pressure.

11. A method of operating an internal combustion engine including at least one cylinder and a piston slidable in the cylinder, the method comprising:

imparting rotational movement to a first turbine and a first compressor of a first turbocharger with exhaust air flowing from an exhaust port of the cylinder;

imparting rotational movement to a second turbine and a second compressor of a second turbocharger with exhaust air flowing from an exhaust duct of the first turbocharger;

compressing air drawn from atmosphere with the second compressor;

compressing air received from the second compressor with the first compressor;

supplying pressurized air from the first compressor to an air intake port of a combustion chamber in the cylinder via an intake manifold;

controllably operating a fuel supply system to inject fuel directly into the combustion chamber; and

selectively operating an air intake valve to open the air intake port to allow pressurized air to flow between the combustion chamber and the intake manifold during a portion of a compression stroke of the piston.

12. The method of claim 11, wherein said selectively operating includes operating a variable intake valve closing mechanism to interrupt cyclical movement of the intake valve.

13. The method of claim 11, wherein the selective operation of the air intake valve is based on at least one engine condition.

14. The method of claim 11, wherein said selectively operating includes operating the intake valve to remain open for a portion of a second half of the compression stroke of the piston.

15. The method of claim 11, wherein said controllably operating a fuel supply system includes operating a fuel injector assembly at least one of hydraulically, mechanically, and electronically.

16. An internal combustion engine, comprising:

a block defining at least one cylinder;

a head connected with said block, said head having an air intake port and an exhaust port;

a piston slidable in each cylinder;

an air intake valve controllably movable to open and close the air intake port;

a first turbocharger including a first turbine coupled with a first compressor, the first turbine being in fluid communication with the exhaust port, the first compressor being in fluid communication with the air intake port;

a second compressor being in fluid communication with atmosphere and the first compressor;

a fuel supply system operable to controllably inject fuel into the combustion chamber; and

a controller configured to selectively operate the air intake valve to remain open during a portion of a compression stroke of the piston.

17. The engine of claim 16, wherein said second compressor is coupled with said first turbine.

18. The engine of claim 16, wherein the controller is configured to operate the intake valve to remain open for a portion of a second half of the compression stroke of the piston.

19. The engine of claim 16, wherein the fuel supply system includes a fuel injector assembly.

20. An internal combustion engine, comprising:

a block defining at least one cylinder;

a head connected with said block, said head having an air intake port and an exhaust port;

a piston slidable in each cylinder;

an air intake valve assembly connectable with a cam assembly to controllably move an intake valve to open and close the air intake port;

a first turbocharger including a first turbine coupled with a first compressor, the first turbine being in fluid communication with the exhaust port and an exhaust duct, the first compressor being in fluid communication with the air intake port;

a second turbocharger including a second turbine coupled with a second compressor, the second turbine being in fluid communication with the exhaust duct of the first turbocharger and atmosphere, the second compressor being in fluid communication with atmosphere and the first compressor;

a fuel supply system connectable with a cam assembly operable to controllably inject fuel into the combustion chamber; and

a variable intake valve mechanism connectable with said air intake valve, said variable intake valve mechanism being adaptable to interrupt cyclical movement of said intake valve.

21. The engine of claim 20, wherein said first turbocharger and said second turbocharger are similarly sized.

22. The engine of claim 20, wherein said variable valve mechanism is actuated at least one of hydraulically, pneumatically, mechanically, and electronically.

23. The engine of claim 20, further including an air cooler between at least one of said first compressor and said second compressor.